PATENT ABSTRACTS OF JAPAN

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(54) PIEZOELECTRIC ELECTROACOUSTIC TRANSDUCER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a piezoelectric electroacoustic transducer in which dimensional difference between a case and a piezoelectric sounding body is reduced as much as possible, a resonance frequency is low and a sound pressure is high.

SOLUTION: In the piezoelectric electroacoustic transducer provided with a piezoelectric sounding body 1 performing bending vibration by the application of an alternating signal between two electrodes, a case 20 for housing the piezoelectric sounding body 1 and a pair of terminals 22 and 23 insert-molded in the case, internal connecting parts 22a and 23a of the pair of terminals 22 and 23 are exposed on an inner lateral side of a sidewall portion of the case 20 approximately vertically to the piezoelectric sounding body 1, and the internal connecting parts of the terminals and the electrodes of the piezoelectric sounding body are electrically connected by conductive adhesives 33. The internal connecting parts 22a and 23a of the terminals are not remarkably expanded inside of the case 20, so that the dimensional difference between the case 20 and the piezoelectric sounding body 1 is reduced.

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[Date of requesting appeal against
examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1]

In the piezo-electric mold electroacoustic transducer equipped with the piezo-electric sounding body which carries out crookedness vibration by impressing an alternation signal to inter-electrode [two], the case which contains the above-mentioned piezo-electric sounding body, and the terminal of the pair by which insert molding was carried out to the above-mentioned case,

The internal connection section of the terminal of a top Norikazu pair is perpendicularly exposed to the medial surface of the side-attachment-wall section of the above-mentioned case mostly to the above-mentioned piezo-electric sounding body,

The piezo-electric mold electroacoustic transducer characterized by the internal connection section of the above-mentioned terminal and the electrode of the above-mentioned piezo-electric sounding body being electrically connected by electroconductive glue.

[Claim 2]

The above-mentioned piezo-electric sounding body is formed in a square,

The terminal of a top Norikazu pair is exposed to the medial surface of the two side-attachment-wall sections which a case counters,

Inside the side-attachment-wall section of the above-mentioned case, the supporter which supports four sides of the piezo-electric sounding body is formed, and the above-mentioned piezo-electric sounding body is in the condition laid in the above-mentioned supporter. The piezo-electric mold electroacoustic transducer according to claim 1 characterized by being fixed by the elastic adhesives by which the above-mentioned electroconductive glue by which the electrode of the piezo-electric sounding body and the internal connection section of a terminal were applied between them connected electrically, and the periphery section and the case of the piezo-electric sounding body were applied between them.

[Claim 3]

The above-mentioned terminal is a terminal of a cross-section L typeface,

The piezo-electric mold electroacoustic transducer according to claim 1 or 2 characterized by for the part which stood up above the above-mentioned terminal being the above-mentioned internal connection section, and the part prolonged to the inside of a case along the base of a case being an external connection.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to piezo-electric mold electroacoustic transducers, such as a piezo-electric sounder, and a piezoelectric loudspeaker, a piezo-electric receiver.

[0002]

[Description of the Prior Art]

Conventionally, in electronic equipment, home electronics, a portable telephone, etc., the piezo-electric sounder and the piezo-electric receiver which generate an alarm tone and a sound of operation are used widely. This kind of piezo-electric mold electroacoustic transducer has a common thing using the piezo-electric sounding body of the uni-morph mold which stuck on the front rear face the piezo electric crystal which consists of a piezo-electric ceramic in which the electrode was formed on one side of a metal plate.

Moreover, the piezo-electric mold electroacoustic transducer using the piezo-electric sounding body of the bimorph mold which consists of a piezo-electric ceramic of a laminated structure is also proposed (JP,2001-95094,A 3 **).

[0003]

Drawing 8 is an example of the conventional piezo-electric mold electroacoustic transducer, and, as for 40, a case and 41 are the piezo-electric sounding body and the terminal with which covering and 42 were set to 43 and insert molding of 44 was carried out to the case 40. The end section of the terminals 43 and 44 which support the both ends of the piezo-electric sounding body 42 is horizontally exposed to the internal both ends of a case 40. The electrode section of the piezo-electric sounding body 42 is electrically connected by electroconductive glue 46 on terminals 43 and 44, the elastic adhesives 47, such as silicone rubber, are applied from on the, and the perimeter of the piezo-electric sounding body 42 is fixed to a case 40.

However, if direct continuation of the piezo-electric sounding body 42 is carried out with electroconductive glue 46 on terminals 43 and 44 in this way, since the both ends of the piezo-electric sounding body 42 will be restrained strongly, the amount of displacement of the piezo-electric sounding body 42 will become small, and sound pressure will fall.

[0004]

Then, like drawing 9 , the applicant for this patent formed the supporter 45 in the part of the case 40 inside the insertion terminals 43 and 44, supported the piezo-electric sounding body 42 to this supporter 45, and after he covers the end face of the piezo-electric sounding body 42 by the insulating agent 48 with elasticity, he has proposed the structure which applied electroconductive glue 46 between the piezo-electric sounding body 42 and terminals 43 and 44 ranging over the insulating agent 48 (application for patent No. 193305 [2001 to]). In addition, after applying electroconductive glue 46, the perimeter of the piezo-electric sounding body 42 is fixed to a case 40 by elastic adhesives (not shown).

In this case, since the both ends of the piezo-electric sounding body 42 are not strongly restrained in a case 40, there is an advantage that the amount of displacement of the piezo-electric sounding body 42 becomes large, and sound pressure becomes large.

[0005]

[Problem(s) to be Solved by the Invention]
Only predetermined die length needs to expose terminals 43 and 44 to the inside of a case 40 in order to secure conductivity with electroconductive glue 46. However, if the supporter 45 which supports the piezo-electric sounding body 42 is formed inside terminals 43 and 44 as mentioned above, only the exposure length of terminals 43 and 44 must make small the dimension S of the piezo-electric sounding body 42 compared with the dimension L of a case 40. That the miniaturization is demanded and a piezo-electric mold electroacoustic transducer also miniaturizes a case 40 with the miniaturization of electronic equipment in recent years means that the dimension S of the piezo-electric sounding body 42 becomes still smaller. If the dimension S of the piezo-electric sounding body 42 becomes small, since the resonance frequency becomes high and sound pressure becomes small, it is not desirable. Therefore, it is important to make variation of tolerance of the dimension L of a case 40 and the dimension S of the piezo-electric sounding body 42 as small as possible.
[0006]
Then, the purpose of this invention makes variation of tolerance of a case and the piezo-electric sounding body as small as possible, and its resonance frequency is low, and it is to offer a piezo-electric mold electroacoustic transducer with big sound pressure.
[0007]
[Means for Solving the Problem]
In order to attain the above-mentioned purpose, invention according to claim 1 In the piezo-electric mold electroacoustic transducer equipped with the piezo-electric sounding body which carries out crookedness vibration by impressing an alternation signal to inter-electrode [two], the case which contains the above-mentioned piezo-electric sounding body, and the terminal of the pair by which insert molding was carried out to the above-mentioned case The internal connection section of the terminal of a top Norikazu pair is perpendicularly exposed to the medial surface of the side-attachment-wall section of the above-

mentioned case mostly to the above-mentioned piezo-electric sounding body, and the piezo-electric mold electroacoustic transducer characterized by the internal connection section of the above-mentioned terminal and the electrode of the above-mentioned piezo-electric sounding body being electrically connected by electroconductive glue is offered.

[0008]

Since the internal connection section of a terminal is exposed to the medial surface of the side-attachment-wall section of a case, the periphery edge of the piezo-electric sounding body can be brought close to the side-attachment-wall section of a case, and variation of tolerance of a case and the piezo-electric sounding body can be made small. Therefore, even if the dimension of a case is the same, the dimension of the piezo-electric sounding body can be enlarged compared with the former, it is low in the resonance frequency of the piezo-electric sounding body, and sound pressure can be enlarged. Although the terminal exposed mostly perpendicularly and the electrode of the piezo-electric sounding body are electrically connected by electroconductive glue, since the exposure length of a terminal is obtained with the height of the side-attachment-wall section of a case, he can secure the touch area of electroconductive glue and the outcrop of a terminal, and can acquire flow dependability.

[0009]

Where formed the piezo-electric sounding body in the square, it exposed the terminal of a pair to the medial surface of the two side-attachment-wall sections which a case counters like claim 2, it formed the supporter which supports four sides of the piezo-electric sounding body inside the side-attachment-wall section of a case and the piezo-electric sounding body is laid in a supporter It is good to fix with the elastic adhesives to which it connected with electrically with the electroconductive glue to which the electrode of the piezo-electric sounding body and the internal connection section of a terminal were applied between them, and the periphery section and the case of the piezo-electric sounding body were applied between them.

The square piezo-electric sounding body has the large amount of displacement compared with the piezo-electric circular sounding body, and is excellent in sound conversion efficiency. When containing the piezo-electric sounding body of such a square inside a case, the periphery section of the piezo-electric sounding body is laid in the supporter formed inside the side-attachment-wall section of a case, and by applying electroconductive glue from on the, the both ends of the piezo-electric sounding body are not restrained strongly, but can enlarge the amount of displacement of the piezo-electric sounding body. Furthermore, by applying elastic adhesives between the periphery section of the piezo-electric sounding body, and a case, while the piezo-electric sounding body is fixed to a case, the closure of the clearance between the piezo-electric sounding body and a case is carried out. Since these adhesives have elasticity, the piezo-electric sounding body can be displaced easily.

[0010]

It is good also considering the part which makes the part which stood up above the terminal the internal connection section like claim 3, using the terminal of a cross-section L typeface as a terminal, and is prolonged to the inside of a case along the base of a case as an external connection.

In this case, the configuration of a terminal is simple and bending after insert molding is also unnecessary. In the case of a KO typeface terminal like before, after inserting an almost plate-like terminal, the part projected out of the case was bent so that a case might be met, but in the case of L typeface terminal, such bending is unnecessary, and problems, such as curvature by the springback of a terminal, do not have it in it, either.

[0011]

[Embodiment of the Invention]

Drawing 1 - drawing 4 show the piezo-electric sounder which is an example of the piezo-electric mold electroacoustic transducer concerning this invention. This piezo-electric sounder consists of the piezo-electric sounding bodies 1, the cases 20, and coverings 30 of a profile and a uni-morph mold. A case consists of

a case 20 and covering 30.

[0012]

The piezo-electric sounding body 1 consists of an abbreviation square-like metal plate 2, an insulating layer 3 formed all over the front face of a metal plate 2, and a piezo electric crystal 4 of the shape of an abbreviation square smaller than the metal plate 2 by which adhesion immobilization was carried out on the insulating layer 3, as shown in drawing 5 and drawing 6 .

The ingredient equipped with spring elasticity of a metal plate 2 is desirable, for example, phosphor bronze, 42nickel, etc. are used. In addition, since ceramics (PZT etc.) and the coefficient of thermal expansion are near when a metal plate 3 is 42nickel, what has more high dependability is obtained. An insulating layer 3 can also be constituted from resin coatings, such as polyimide and epoxy, and may form an oxide coat by oxidation treatment.

[0013]

a piezo electric crystal 4 -- the two-layer piezo-electric ceramic layers 4a and 4b -- the condition of a green sheet -- an internal electrode 5 -- between -- carrying out -- a laminating -- carrying out -- coincidence baking -- carrying out -- a front rear face -- the external electrodes 6 and 7 are mostly formed in the whole surface. As an arrow head P shows to drawing 6 , polarization of each piezo-electric ceramic layers 4a and 4b is carried out to the reverse sense in the thickness direction. Although one of them has exposed the internal electrode 5 to the end face of a piezo electric crystal 4, as for the side of the opposite side, only fixed distance serves as termination from the end face of a piezo electric crystal 4 in this side. The external electrodes 6 and 7 of the front flesh side of a piezo electric crystal 4 are mutually connected through one end-face electrode 8, and the internal electrode 5 is connected with the drawer electrodes 10 and 11 formed in the front rear face through the other-end side electrode 9. The drawer electrodes 10 and 11 are small electrodes formed along the center section of the one side of a piezo electric crystal 4, and are electrically separated with the external electrodes 6 and 7 of a front flesh side. Although one end-face electrode

8 has the die length equivalent to one side of a piezo electric crystal 4, the other-end side electrode 9 is made into the die length according to the die length of the drawer electrodes 10 and 11. In addition, in this example, although the drawer electrodes 10 and 11 were formed not only in a front face but in the rear face, this is for abolishing the directivity of a piezo electric crystal 4, and the drawer electrode 11 on the back may be omitted. Moreover, it is good also as die length which is equivalent to one side of a piezo electric crystal 4 in the drawer electrodes 10 and 11.

The rear face of a piezo electric crystal 4 is pasted up on the center-section top face of an insulating layer 3 with the adhesives 12 (refer to drawing 5), such as epoxy system adhesives. The metal plate 2 is more large-sized than a piezo electric crystal 4, and the insulating layer 3 is continuously formed also in the front face of extension 2a which extends to the method of outside [piezo electric crystal / 4].

[0014]

The case 20 is formed in the core box of the abbreviation square which has a bottom wall and four side attachment walls with insulating ingredients, such as ceramics or resin. When forming a case 20 by resin, heat-resistant resin, such as LCP (liquid crystal polymer), SPS (syndiotactic polystyrene), PPS (polyphenylene sulfide), and epoxy, is desirable. Inside the side attachment wall of a case 20, the supporter 21 which receives the sounding body 1 by the perimeter was formed, and the internal connection sections 22a and 23a of the terminals 22 and 23 electrically connected to the front-face side external electrode 6 and the drawer electrode 10 of the sounding body 1, respectively are exposed to the medial surface of two side attachment walls which counter. Moreover, between a supporter 21 and the internal connection sections 22a and 23a of terminals 22 and 23, the septum section 24 is formed in one from the case 20 (refer to drawing 4). This septum section 24 is functioning as a spacer with which a metal plate 2 prevents contacting terminals 22 and 23, when a metal plate 2 is laid on a supporter 21 so that it may mention later.

[0015]
Terminals 22 and 23 are terminals by which insert molding was carried out to the case 20, as shown in drawing 7 , bend perpendicularly upwards the heels 22a and 23a of the terminals 22 and 23 pierced in one from the hoop 29, and make this bending section the internal connection section with the sounding body 1. Thus, by making the internal connection sections 22a and 23a stand up perpendicularly to a case base (sounding body 1), the internal connection sections 22a and 23a do not ****** inside a case 20, but can make variation of tolerance of the dimension L of a case 20, and the dimension S of the piezo-electric sounding body 1 as small as possible. Consequently, it is low in the resonance frequency of the piezo-electric sounding body 1, and sound pressure can be enlarged. The external connections 22b and 23b of terminals 22 and 23 are prolonged to the inside so that the base of a case 20 may be met.
[0016]
The bottom sound emission hole 25 is formed in the pars-basilaris-ossis-occipitalis side of a side attachment wall, and the slot 26 for sound emission is formed in the crowning of the side attachment wall of another side for while having not formed the terminals 22 and 23 of a case 20. The covering 30 of this example is formed in plate-like with the case 20 and the ingredient of the same kind. By pasting up covering 30 on the crowning of the side attachment wall of a case 20 with adhesives 31, a slot 26 serves as a top sound emission hole.
In addition, it is not necessary to make covering 30 plate-like, and it may be the cap configuration of a cross-section abbreviation concave. Moreover, the hole which did not have to use as the slot established in the side-attachment-wall crowning of a case 20, and was prepared in covering 30 is sufficient as the top sound emission hole 26.
[0017]
The piezo-electric sounding body 1 is contained in a case 20 so that the metal plate 2 may meet a bottom wall, and the periphery is laid on a supporter 21. Next, between the edge of a metal plate 2, and the internal connection sections 22a

and 23a of terminals 22 and 23, the insulating agent 32 is applied to a line and hardened. It is better to use adhesives with elasticity, such as an urethane system and a silicone system, although what kind of insulating adhesives may be used as an insulating agent 32. Next, electroconductive glue 33 is applied and hardened in the rectangular direction to the above-mentioned insulating agent 32 between the front-face side external electrode 6 and internal connection section 22a of a terminal 22, and between the drawer electrode 10 and internal connection section 23a of a terminal 23. Although it has stood up perpendicularly, since it has exposed in a large area, the internal connection sections 22a and 23a of terminals 22 and 23 have a large flow area with electroconductive glue 33, and its flow dependability is high. What contains a conductive filler in adhesives with elasticity, such as an urethane system, as electroconductive glue 33 is good. Although electroconductive glue 33 is applied on a metal plate 2, since an insulating layer 3 is beforehand formed on a metal plate 2 and the periphery edge of a metal plate 2 is covered by the insulating agent 32, electroconductive glue 33 does not contact a metal plate 2 directly. Next, between the perimeter perimeter of a metal plate 2 and cases 20 is fixed with adhesives 34. Although these adhesives 34 should just use well-known insulating adhesives, it is good to use adhesives with elasticity, such as an urethane system and a silicone system. After fixing the sounding body 1 to a case 20 as mentioned above, covering 30 pastes top-face opening of a case 20 with adhesives 31. By pasting up covering 30, sound space is formed between covering 30 and the sounding body 1 and between the sounding body 1 and the pars basilaris ossis occipitalis of a case 20, and the piezo-electric sounder of a surface mount mold is completed.

[0018]

As adhesives 32, 33, and 34 which fix the sounding body 1 and a case 20 as mentioned above, by using a spring material, the variation rate of the sounding body 1 is made to the maximum, and it becomes possible to obtain big sound pressure.

Moreover, since the electrode section (the front-face side external electrode 6

and drawer electrode 10) of the sounding body 1 and the electrode section (terminals 22 and 23) of a case 20 are connected with electroconductive glue 33, electric dependability improves compared with the case where a flow is taken through a metal plate 2. And since electroconductive glue 33 can be applied from the upper part of a case 20 with coaters, such as a dispenser, it can raise manufacture effectiveness and quality compared with the case where automation is easy and solders lead wire.

[0019]

If the signal of a frequency almost equal to the resonance frequency of the sounding body 1 is impressed between the terminal 22 prepared in the above-mentioned case 20, and 23, since a piezo electric crystal 4 expands and contracts in the direction of a flat surface, and it does not expand and contract a metal plate 2, as for the sounding body 1, flexion deformity is caused as a whole. Since the periphery of the sounding body 1 is supported by the case 20 and the closure of between the side front of the sounding body 1 and backgrounds is carried out with adhesives 34, a predetermined acoustic wave can be generated. This acoustic wave is emitted to the exterior from the top sound emission hole 26.

[0020]

The dimension of each part article in the above-mentioned example is as follows.

Piezo electric crystal 4:6.8mmx6.8mmx30micrometer (in a two-layer case, the thickness of each class is 15 micrometers)

Metal plate 2:8.0mmx8.0mmx20micrometer

Insulating-layer 3:8.0mmx8.0mmx3micrometer

Case 20:9.0mmx9.0mmx2.6mm

As mentioned above, since the internal connection sections 22a and 23a of terminals 22 and 23 were exposed to the medial surface of the side attachment wall of a case 10 and it was made to stand up perpendicularly to a case base (sounding body 1), the internal connection sections 22a and 23a were not able to ****** greatly to the inside of a case 10, but were able to bring the dimension S of the piezo-electric sounding body 1 close as much as possible to the dimension L

of a case 20. In the case of structure, S/L was able to make S/L about 90% with the structure of this example to having been 85% at the maximum conventionally like drawing 9 . Consequently, since the dimension S of the piezo-electric sounding body 1 was enlarged even when the dimension L of a case was the same, compared with the former, resonance frequency could be made low, and sound pressure was able to be enlarged.

[0021]

This invention is not limited to the above-mentioned example.

A piezo electric crystal may be not only a two-layer laminated structure but three layers or more, and veneer structure is sufficient as it.

Moreover, a metal plate and a piezo electric crystal may be not only a square but a rectangle, or a round shape. A metal plate does not need to be more large-sized than a piezo electric crystal, and may be the same configuration as a piezo electric crystal.

The piezo-electric sounding body of this invention may be the piezo-electric sounding body of the bimorph structure which does not restrict to the uni-morph structure where the piezo electric crystal was stuck on the metal plate, and becomes JP,2001-95094,A from a laminating piezo-electricity ceramic like a publication.

Although the supporter which supports four sides of the piezo-electric sounding body was formed inside the case which constitutes a case, the part which does not have a supporter is [that what is necessary is just to form a supporter in two sides which the terminal exposed at least, or four corners] also good to close with elastic encapsulant.

Although the septum section 24 was formed inside the side attachment wall of a case 20 in the above-mentioned example, this septum section 24 is for preventing that a metal plate 2 and terminals 22 and 23 contact, and if it is the piezo-electric sounding body by which the polar zone was formed in the edge, it is also possible to omit the septum section 24. For the same reason, the insulating agent 32 applied to the periphery section of a metal plate 2 is also

omissible.
Although a concave case and covering which closes the opening constituted the case from the above-mentioned example, the configuration of a case is not restricted to this.
This invention is applicable not only to the pronunciation components used in a resonance field like a piezo-electric sounder but the pronunciation components corresponding to the frequency of a large range like a piezo-electric receiver.
Moreover, an alternation signal includes not only an AC signal but a square wave signal by this invention.
[0022]
[Effect of the Invention]
Since the internal connection section of the terminal which was inserted to the case according to invention concerning claim 1 so that clearly was perpendicularly exposed to the medial surface of the side-attachment-wall section of a case at the above explanation and the internal connection section of a terminal and the electrode of the piezo-electric sounding body were connected with electroconductive glue, the internal connection section of a terminal does not ****** greatly to the inside of a case, but can make small variation of tolerance of a case and the piezo-electric sounding body. Therefore, the dimension of the piezo-electric sounding body can be enlarged relatively, it is low in the resonance frequency of the piezo-electric sounding body, and sound pressure can be enlarged.
Moreover, although the terminal exposed perpendicularly and the electrode of the piezo-electric sounding body are electrically connected by electroconductive glue, since the touch area of electroconductive glue and the outcrop of a terminal is securable, flow dependability can be acquired.
[Brief Description of the Drawings]
[Drawing 1] It is the decomposition perspective view of an example of the piezo-electric mold electroacoustic transducer concerning this invention.
[Drawing 2] It is the top view from which covering and adhesives of a piezo-

electric mold electroacoustic transducer which are shown in drawing 1 were excepted.

[Drawing 3] It is the A-A line sectional view of drawing 2 .

[Drawing 4] a part of drawing 3 -- it is an enlarged drawing.

[Drawing 5] It is the decomposition perspective view of the piezo-electric sounding body.

[Drawing 6] It is the sectional view of the piezo-electric sounding body.

[Drawing 7] It is drawing showing the insert molding condition of a terminal and a case.

[Drawing 8] It is the sectional view of an example of the conventional piezo-electric mold electroacoustic transducer.

[Drawing 9] It is the sectional view of other examples of the conventional piezo-electric mold electroacoustic transducer.

[Description of Notations]

1 Piezo-electric Sounding Body

2 Metal Plate

4 Piezo Electric Crystal

6 Seven External electrode

10 11 Drawer electrode

20 Case (Case)

21 Supporter

22 23 Terminal

22a and 23a Internal connection section

22b, 23b External connection

30 Covering (Case)

33 Electroconductive Glue

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the decomposition perspective view of an example of the piezo-electric mold electroacoustic transducer concerning this invention.

[Drawing 2] It is the top view from which covering and adhesives of a piezo-electric mold electroacoustic transducer which are shown in drawing 1 were excepted.

[Drawing 3] It is the A-A line sectional view of drawing 2 .

[Drawing 4] a part of drawing 3 -- it is an enlarged drawing.

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[Drawing 9] It is the sectional view of other examples of the conventional piezo-electric mold electroacoustic transducer.

[Description of Notations]

1 Piezo-electric Sounding Body

2 Metal Plate

4 Piezo Electric Crystal

6 Seven External electrode

10 11 Drawer electrode

20 Case (Case)

21 Supporter

22 23 Terminal

22a and 23a Internal connection section

22b, 23b External connection

30 Covering (Case)

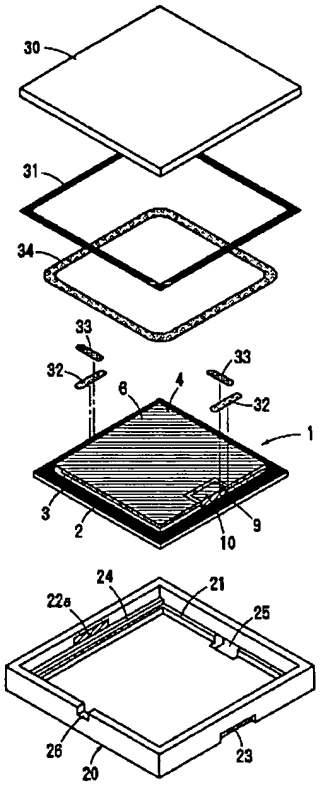
33 Electroconductive Glue

[Translation done.]

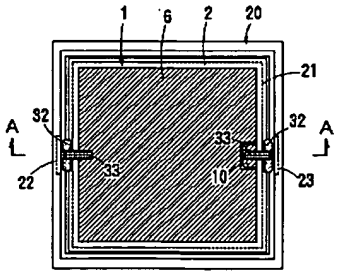
* NOTICES *

DRAWINGS

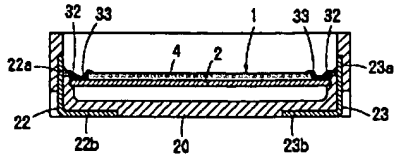
[Drawing 1]



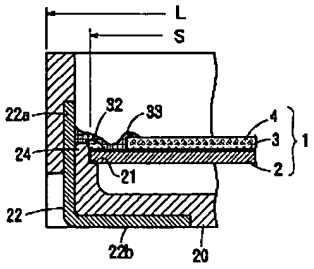
[Drawing 2]



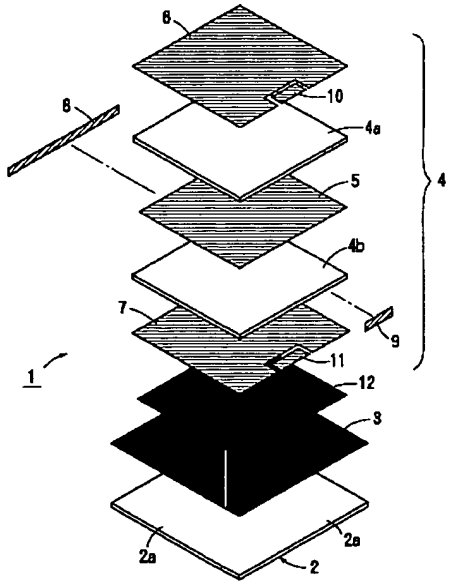
[Drawing 3]



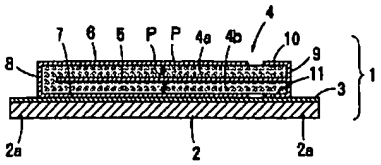
[Drawing 4]



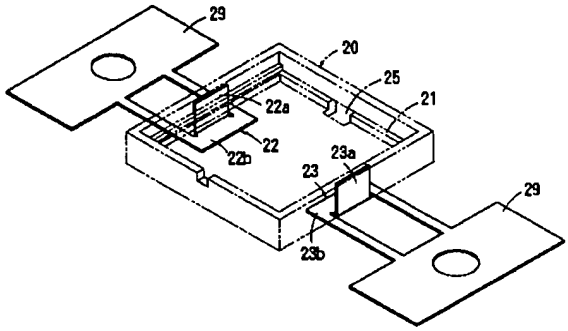
[Drawing 5]



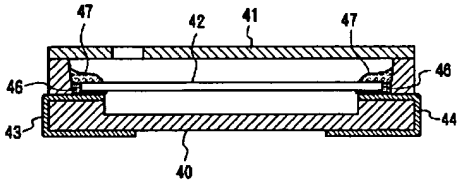
[Drawing 6]



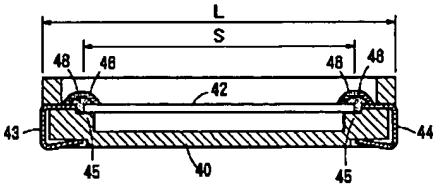
[Drawing 7]



[Drawing 8]



[Drawing 9]



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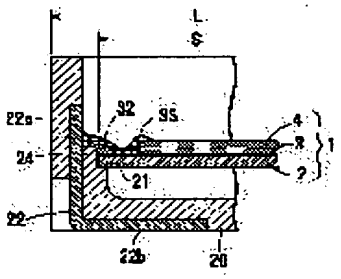
(54) PIEZOELECTRIC ELECTROACOUSTIC TRANSDUCER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a piezoelectric electroacoustic transducer in which dimensional difference between a case and a piezoelectric sounding body is reduced as much as possible, a resonance frequency is low and a sound pressure is high.
SOLUTION: In the piezoelectric electroacoustic transducer provided with a piezoelectric sounding body 1 performing bending vibration by the application of an alternating signal between two electrodes, a case 20 for housing the piezoelectric sounding body 1 and a pair of terminals 22 and 23 insert-molded in the case, internal connecting parts 22a and 23a of the pair of terminals 22 and 23 are exposed on an inner lateral side of a sidewall portion of the case 20 approximately vertically to the piezoelectric sounding body 1, and the internal connecting parts of the terminals and the electrodes of the piezoelectric sounding body are electrically connected by conductive adhesives 33. The internal connecting parts 22a and 23a of the terminals are not remarkably expanded inside of the case 20, so that the dimensional difference between the case 20 and the piezoelectric sounding body 1 is reduced.



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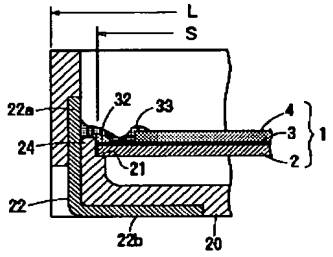
(54)【発明の名称】圧電型電気音響変換器

(57)【要約】
【課題】ケースと圧電発音体との寸法差をできるだけ小さくし、共振周波数が低く、音圧が大きな圧電型電気音響変換器を提供する。
【解決手段】２つの電極間に交番信号を印加することにより屈曲振動する圧電発音体１と、圧電発音体１を収納するケース２０と、ケースにインサート成形された一対の端子２２，２３とを備えた圧電型電気音響変換器であって、一対の端子２２，２３の内部接続部２２ａ，２３ａが、ケース２０の側壁部の内側面に圧電発音体１に対してほぼ垂直方向に露出しており、端子の内部接続部と圧電発音体の電極とが導電性接着剤３３により電気的に接続されている。端子の内部接続部２２ａ，２３ａがケース２０の内側へ大きく張り出さず、ケース２０と圧電発音体１との寸法差を小さくできる。
【選択図】　図４



【特許請求の範囲】
【請求項１】
２つの電極間に交番信号を印加することにより屈曲振動する圧電発音体と、上記圧電発音体を収納する筐体と、上記筐体にインサート成形された一対の端子とを備えた圧電型電気音響変換器において、
上記一対の端子の内部接続部が、上記筐体の側壁部の内側面に上記圧電発音体に対してほぼ垂直方向に露出しており、
上記端子の内部接続部と上記圧電発音体の電極とが導電性接着剤により電気的に接続されていることを特徴とする圧電型電気音響変換器。
【請求項２】
上記圧電発音体は四角形に形成され、
上記一対の端子は筐体の対向する２つの側壁部の内側面に露出しており、
上記筐体の側壁部の内側には、圧電発音体の４辺を支持する支持部が設けられ、上記圧電発音体は上記支持部に載置された状態で、圧電発音体の電極と端子の内部接続部とがその間に塗布された上記導電性接着剤により電気的に接続され、圧電発音体の外周部と筐体とがその間に塗布された弾性接着剤により固定されていることを特徴とする請求項１に記載の圧電型電気音響変換器。
【請求項３】
上記端子は断面Ｌ字形の端子であり、
上記端子の上方に起立した部分が上記内部接続部であり、筐体の底面に沿って筐体の内側へ延びる部分が外部接続部であることを特徴とする請求項１または２に記載の圧電型電気音響変換器。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は圧電サウンダや圧電スピーカ、圧電レシーバなどの圧電型電気音響変換器に関するものである。
【０００２】
【従来の技術】
従来、電子機器、家電製品、携帯電話機などにおいて、警報音や動作音を発生する圧電サウンダや圧電レシーバが広く用いられている。この種の圧電型電気音響変換器は、金属板の片面に、表裏面に電極を形成した圧電セラミックよりなる圧電体を貼り付けたユニモルフ型の圧電発音体を用いたものが一般的である。
また、積層構造の圧電セラミックからなるバイモルフ型の圧電発音体を用いた圧電型電気音響変換器も提案されている（特開２００１－９５０９４号公報参　照）。
【０００３】
図８は従来の圧電型電気音響変換器の一例であり、４０はケース、４１はカバー、４２は圧電発音体、４３，４４はケース４０にインサート成形された端子である。ケース４０の内部両端には、圧電発音体４２の両端部を支持する端子４３，４４の一端部が水平に露出している。圧電発音体４２の電極部分は端子４３，４４の上に導電性接着剤４６により電気的に接続され、その上からシリコーンゴムなどの弾性接着剤４７が塗布されて圧電発音体４２の周囲がケース４０に固定される。
ところが、このように端子４３，４４の上に圧電発音体４２を導電性接着剤４６によって直接接続すると、圧電発音体４２の両端部が強く拘束されるため、圧電発音体４２の変位量が小さくなり、音圧が低下してしまう。
【０００４】
そこで、本願出願人は、図９のように、インサート端子４３，４４より内側のケース４０の部位に支持部４５を設け、この支持部４５に圧電発音体４２を支持し、弾性を持つ絶縁剤４８で圧電発音体４２の端面を覆った後、絶縁剤４８を跨いで導電性接着剤４６を圧電発音体４２と端子４３，４４との間に塗布した構造を提案している（特願２００１－１９

３３０５号）。なお、導電性接着剤４６を塗布した後、弾性接着剤（図示せず）によって圧電発音体４２の周囲がケース４０に固定される。
この場合には、圧電発音体４２の両端部がケース４０によって強く拘束されないので、圧電発音体４２の変位量が大きくなり、音圧が大きくなるという利点がある。
【０００５】
【発明が解決しようとする課題】
端子４３，４４は導電性接着剤４６との導通性を確保するため、所定の長さだけケース４０の内側へ露出する必要がある。ところが、上記のように端子４３，４４の内側に圧電発音体４２を支持する支持部４５を設けると、端子４３，４４の露出長だけ圧電発音体４２の寸法Ｓをケース４０の寸法Ｌに比べて小さくしなければならない。近年、電子機器の小型化に伴い、圧電型電気音響変換器も小型化が要求されており、ケース４０を小型化するということは、圧電発音体４２の寸法Ｓがさらに小さくなることを意味する。圧電発音体４２の寸法Ｓが小さくなると、その共振周波数が高くなり、音圧が小さくなるため望ましくない。そのため、ケース４０の寸法Ｌと圧電発音体４２の寸法Ｓとの寸法差をできるだけ小さくすることが重要である。
【０００６】
そこで、本発明の目的は、ケースと圧電発音体との寸法差をできるだけ小さくし、共振周波数が低く、音圧が大きな圧電型電気音響変換器を提供することにある。
【０００７】
【課題を解決するための手段】
上記目的を達成するため、請求項１に記載の発明は、２つの電極間に交番信号を印加することにより屈曲振動する圧電発音体と、上記圧電発音体を収納する筐体と、上記筐体にインサート成形された一対の端子とを備えた圧電型電気音響変換器において、上記一対の端子の内部接続部が、上記筐体の側壁部の内側面に上記圧電発音体に対してほぼ垂直方向に露出しており、上記端子の内部接続部と上記圧電発音体の電極とが導電性接着剤により電気的に接続されていることを特徴とする圧電型電気音響変換器を提供する。
【０００８】
端子の内部接続部は筐体の側壁部の内側面に露出するので、筐体の側壁部に圧電発音体の外周縁を近づけることができ、ケースと圧電発音体との寸法差を小さくできる。そのため、ケースの外形寸法が同一でも、従来に比べて圧電発音体の寸法を大きくすることができ、圧電発音体の共振周波数を低く、音圧を大きくすることができる。ほぼ垂直方向に露出する端子と圧電発音体の電極とが導電性接着剤により電気的に接続されるが、端子の露出長はケースの側壁部の高さによって得られるので、導電性接着剤と端子の露出部との接触面積を確保することができ、導通信頼性を得ることができる。
【０００９】
請求項２のように、圧電発音体を四角形に形成し、一対の端子を筐体の対向する２つの側壁部の内側面に露出させ、筐体の側壁部の内側に、圧電発音体の４辺を支持する支持部を設け、圧電発音体を支持部に載置した状態で、圧電発音体の電極と端子の内部接続部とをその間に塗布された導電性接着剤により電気的に接続し、圧電発音体の外周部と筐体とをその間に塗布された弾性接着剤により固定するのがよい。
四角形の圧電発音体は、円形の圧電発音体に比べて変位量が大きく、音響変換効率に優れている。このような四角形の圧電発音体を筐体の内部に収納するとき、筐体の側壁部の内側に設けた支持部に圧電発音体の外周部を載置し、その上から導電性接着剤を塗布することで、圧電発音体の両端部が強く拘束されず、圧電発音体の変位量を大きくできる。さらに、圧電発音体の外周部と筐体との間に弾性接着剤を塗布することで、圧電発音体がケースに固定されると同時に、圧電発音体とケースとの隙間が封止される。この接着剤は弾性を持つので、圧電発音体は容易に変位できる。
【００１０】
請求項３のように、端子として断面Ｌ字形の端子を用い、端子の上方に起立した部分を内部接続部とし、筐体の底面に沿って筐体の内側へ延びる部分を外部接続部としてもよい。

この場合には、端子の形状が単純であり、インサート成形後の曲げ加工も不要である。従来のようなコ字形端子の場合には、ほぼ平板状の端子をインサートした後、ケース外に突出した部分をケースに沿うように折り曲げていたが、Ｌ字形端子の場合にはこのような曲げ加工が不要であり、端子のスプリングバックによる反り等の問題もない。

【００１１】

【発明の実施の形態】

図１～図４は本発明にかかる圧電型電気音響変換器の一例である圧電サウンダを示す。

この圧電サウンダは、大略、ユニモルフ型の圧電発音体１とケース２０とカバー３０とで構成されている。ケース２０とカバー３０とで筐体が構成される。

【００１２】

圧電発音体１は、図５，図６に示すように、略正方形状の金属板２と、金属板２の表面全面に形成された絶縁層３と、絶縁層３の上に接着固定された金属板２より小形な略正方形状の圧電体４とで構成されている。

金属板２はバネ弾性を備えた材料が望ましく、例えばリン青銅，４２Ｎｉなどが用いられる。なお、金属板３が４２Ｎｉの場合には、セラミック（ＰＺＴ等）と熱膨張係数が近いので、より信頼性の高いものが得られる。絶縁層３は、ポリイミド、エポキシなどの樹脂コーティングで構成することもできるし、酸化処理によって酸化物被膜を形成してもよい。

【００１３】

圧電体４は、２層の圧電セラミック層４ａ，４ｂをグリーンシートの状態で内部電極５を間にして積層し、同時焼成したものであり、表裏面のほぼ全面に外部電極６，７が設けられている。各圧電セラミック層４ａ，４ｂは、図６に矢印Ｐで示すように厚み方向に逆向きに分極されている。内部電極５は、その一辺が圧電体４の端面に露出しているが、反対側の辺は圧電体４の端面から一定距離だけ手前で終端となっている。圧電体４の表裏の外部電極６，７は一方の端面電極８を介して相互に接続され、内部電極５は他方の端面電極９を介して表裏面に形成された引出電極１０，１１と接続されている。引出電極１０，１１は、圧電体４の１つの辺の中央部に沿って形成された小形の電極であり、表裏の外部電極６，７と電気的に分離されている。一方の端面電極８は圧電体４の１辺に相当する長さを有するが、他方の端面電極９は引出電極１０，１１の長さに応じた長さとしてある。なお、この実施例では、引出電極１０，１１を表面だけでなく裏面にも形成したが、これは圧電体４の方向性をなくすためであり、裏面の引出電極１１は省略してもよい。また、引出電極１０，１１を圧電体４の１辺に相当する長さとしてもよい。

圧電体４の裏面は、エポキシ系接着剤などの接着剤１２（図５参照）によって絶縁層３の中央部上面に接着されている。金属板２は圧電体４より大形であり、圧電体４より外方へ延出する延長部２ａの表面にも絶縁層３が連続的に形成されている。

【００１４】

ケース２０はセラミックスまたは樹脂などの絶縁性材料で底壁と４つの側壁とを持つ略正方形の箱型に形成されている。ケース２０を樹脂で形成する場合には、ＬＣＰ（液晶ポリマー），ＳＰＳ（シンジオタクチックポリスチレン），ＰＰＳ（ポリフェニレンサルファイド），エポキシなどの耐熱樹脂が望ましい。ケース２０の側壁の内側には、発音体１を全周で受ける支持部２１が形成され、対向する２つの側壁の内側面には、発音体１の表面側外部電極６と引出電極１０とにそれぞれ電気的に接続される端子２２，２３の内部接続部２２ａ，２３ａが露出している。また、支持部２１と端子２２，２３の内部接続部２２ａ，２３ａとの間には、ケース２０から一体に隔壁部２４が形成されている（図４参照）。この隔壁部２４は、後述するように支持部２１上に金属板２を載置したとき、金属板２が端子２２，２３に接触するのを防止するスペーサとして機能している。

【００１５】

端子２２，２３はケース２０にインサート成形された端子であり、図７に示すように、フープ材２９から一体的に打ち抜かれた端子２２，２３の外端部２２ａ，２３ａを上方へ垂直に折り曲げ、この折り曲げ部を発音体１との内部接続部としている。このように内部接

続部２２ａ，２３ａをケース底面（発音体１）に対して垂直に起立させることにより、内部接続部２２ａ，２３ａがケース２０の内部へ張り出さず、ケース２０の寸法Ｌと圧電発音体１の寸法Ｓとの寸法差をできるだけ小さくできる。その結果、圧電発音体１の共振周波数を低く、かつ音圧を大きくすることができる。端子２２，２３の外部接続部２２ｂ，２３ｂはケース２０の底面に沿うように内側へ延びている。

【００１６】

ケース２０の端子２２，２３を設けていない一方の側壁の底部側に下側放音孔２５が形成され、他方の側壁の頂部に放音用の溝２６が形成されている。この実施例のカバー３０は、ケース２０と同種の材料で平板状に形成されている。カバー３０をケース２０の側壁の頂部に接着剤３１で接着することにより、溝２６は上側放音孔となる。

なお、カバー３０は平板状とする必要はなく、断面略凹型のキャップ形状であってもよい。また、上側放音孔２６はケース２０の側壁頂部に設けた溝とする必要はなく、カバー３０に設けた孔でもよい。

【００１７】

圧電発音体１は、その金属板２が底壁と対面するようにケース２０の中に収納され、その周辺部が支持部２１上に載置される。次に、絶縁剤３２が金属板２の縁部と端子２２，２３の内部接続部２２ａ，２３ａとの間に線状に塗布され、硬化される。絶縁剤３２としては如何なる絶縁性接着剤を用いても良いが、ウレタン系，シリコーン系などの弾性を持つ接着剤を用いる方がよい。次に、上記絶縁剤３２に対して直交方向に、導電性接着剤３３が表面側外部電極６と端子2･2の内部接続部２２ａとの間、および引出電極１０と端子２３の内部接続部２３ａとの間に塗布され、硬化される。端子２２，２３の内部接続部２２ａ，２３ａは垂直に起立しているが、広い面積で露出しているので、導電性接着剤３３との導通面積が大きく、導通信頼性は高い。導電性接着剤３３としては、ウレタン系などの弾性を持つ接着剤に導電性フィラーを含むものがよい。導電性接着剤３３は金属板２の上に塗布されるが、金属板２の上には絶縁層３が予め設けられ、かつ金属板２の外周縁部は絶縁剤３２で覆われているので、導電性接着剤３３が金属板２に直接接触することがない。次に、金属板２の周囲全周とケース２０との間が接着剤３４で固定される。この接着剤３４は公知の絶縁性接着剤を用いればよいが、ウレタン系，シリコーン系などの弾性を持つ接着剤を使用するのがよい。上記のように発音体１をケース２０に固定した後、ケース２０の上面開口部にはカバー３０が接着剤３１で接着される。カバー３０を接着することで、カバー３０と発音体１との間、および発音体１とケース２０の底部との間には音響空間が形成され、表面実装型の圧電サウンダが完成する。

【００１８】

上記のように発音体１とケース２０とを固定する接着剤３２，３３，３４として、弾性材料を使用することで、発音体１の変位を最大限にでき、大きな音圧を得ることが可能となる。

また、発音体１の電極部分（表面側外部電極６と引出電極１０）と、ケース２０の電極部分（端子２２，２３）とを導電性接着剤３３によって接続しているので、金属板２を介して導通を取る場合に比べて、電気的信頼性が向上する。しかも、導電性接着剤３３は、ディスペンサーなどの塗布装置によってケース２０の上方から塗布することができるので、自動化が容易であり、リード線を半田付けする場合に比べて製造効率および品質を向上させることができる。

【００１９】

上記ケース２０に設けられた端子２２，２３間に、発音体１の共振周波数とほぼ等しい周波数の信号を印加すると、圧電体４が平面方向に伸縮し、金属板２は伸縮しないので、全体として発音体１は屈曲変形を起こす。発音体１の周辺部がケース２０に支持され、発音体１の表側と裏側との間が接着剤３４で封止されているので、所定の音波を発生することができる。この音波は上側放音孔２６から外部へ放出される。

【００２０】

上記実施例における各部品の寸法は以下の通りである。

圧電体４：６．８ｍｍ×６．８ｍｍ×３０μｍ（２層の場合、各層の厚みは１５μｍ）
金属板２：８．０ｍｍ×８．０ｍｍ×２０μｍ
絶縁層３：８．０ｍｍ×８．０ｍｍ×３μｍ
ケース２０：９．０ｍｍ×９．０ｍｍ×２．６ｍｍ
上記のように、端子２２，２３の内部接続部２２ａ，２３ａをケース１０の側壁の内側面に露出させ、ケース底面（発音体１）に対して垂直に起立させたので、内部接続部２２ａ，２３ａがケース１０の内側へ大きく張り出さず、圧電発音体１の寸法Ｓをケース２０の寸法Ｌに対してできるだけ近づけることができた。図９のような従来構造の場合には、Ｓ／Ｌは最大でも８５％であったのに対し、本実施例の構造では、Ｓ／Ｌを約９０％とすることができた。その結果、ケースの寸法Ｌが同一でも、圧電発音体１の寸法Ｓを大きくできるので、従来に比べて共振周波数を低くでき、音圧を大きくすることができた。

【００２１】

本発明は上記実施例に限定されるものではない。
圧電体は２層の積層構造に限らず、３層以上であってもよいし、単板構造でもよい。
また、金属板および圧電体は正方形に限らず、長方形あるいは円形であってもよい。金属板は圧電体より大形である必要はなく、圧電体と同一形状であってもよい。
本発明の圧電発音体は、金属板に圧電体を貼り付けたユニモルフ構造に限るものではなく、特開２００１－９５０９４号公報に記載のような積層圧電セラミックからなるバイモルフ構造の圧電発音体であってもよい。
筐体を構成するケースの内側に、圧電発音体の４辺を支持する支持部を設けたが、少なくとも端子が露出した２辺、あるいは４つの角部に支持部を設ければよく、支持部を有しない箇所は弾性封止剤で封止するだけでもよい。
上記実施例では、ケース２０の側壁の内側に隔壁部２４を設けたが、この隔壁部２４は金属板２と端子２２，２３とが接触するのを防止するためであり、電極部が端部に形成された圧電発音体であれば、隔壁部２４を省略することも可能である。同様の理由により、金属板２の外周部に塗布される絶縁剤３２も省略可能である。
上記実施例では、筐体を凹型のケースとその開口部を閉鎖するカバーとで構成したが、筐体の構成はこれに限るものではない。
本発明は、圧電サウンダのような共振領域で使用される発音部品に限らず、圧電レシーバのような広いレンジの周波数に対応した発音部品にも適用できる。
また、本発明で交番信号とは、交流信号だけでなく矩形波信号を含むものである。

【００２２】

【発明の効果】

以上の説明で明らかなように、請求項１に係る発明によれば、筐体にインサートされた端子の内部接続部が筐体の側壁部の内側面に垂直方向に露出しており、端子の内部接続部と圧電発音体の電極とを導電性接着剤により接続したので、端子の内部接続部がケースの内側へ大きく張り出さず、ケースと圧電発音体との寸法差を小さくできる。そのため、圧電発音体の寸法を相対的に大きくすることができ、圧電発音体の共振周波数を低く、音圧を大きくすることができる。
また、垂直方向に露出する端子と圧電発音体の電極とが導電性接着剤により電気的に接続されるが、導電性接着剤と端子の露出部との接触面積を確保することができるので、導通信頼性を得ることができる。

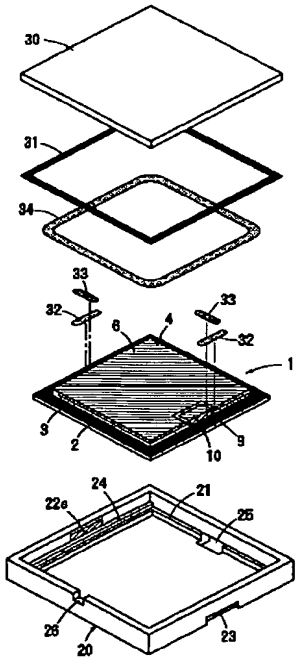
【図面の簡単な説明】

【図１】本発明に係る圧電型電気音響変換器の一例の分解斜視図である。
【図２】図１に示す圧電型電気音響変換器のカバーおよび接着剤を除外した平面図である。
【図３】図２のＡ－Ａ線断面図である。
【図４】図３の一部拡大図である。
【図５】圧電発音体の分解斜視図である。
【図６】圧電発音体の断面図である。

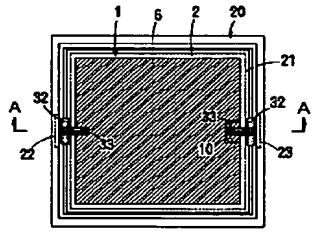
【図７】端子とケースとのインサート成形状態を示す図である。
【図８】従来の圧電型電気音響変換器の一例の断面図である。
【図９】従来の圧電型電気音響変換器の他の例の断面図である。
【符号の説明】

１	圧電発音体
２	金属板
４	圧電体
６，７	外部電極
１０，１１	引出電極
２０	ケース（筐体）
２１	支持部
２２，２３	端子
２２ａ，２３ａ	内部接続部
２２ｂ，２３ｂ	外部接続部
３０	カバー（筐体）
３３	導電性接着剤

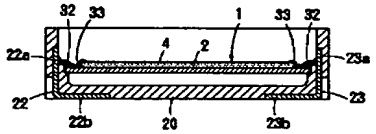
【図１】



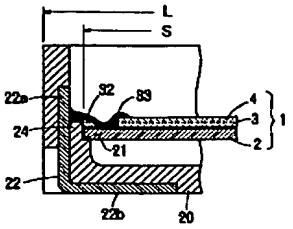
【図２】



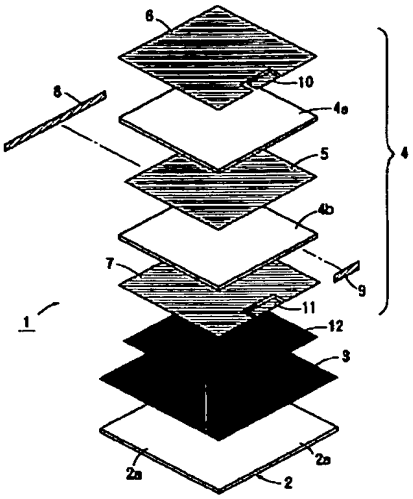
【図３】



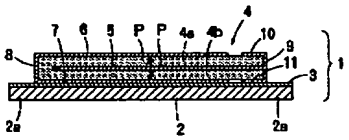
【図４】



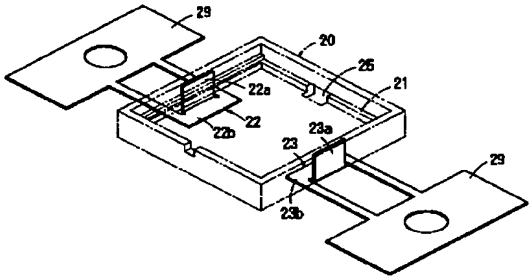
【図５】



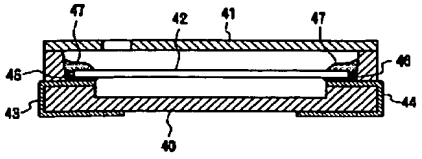
【図６】



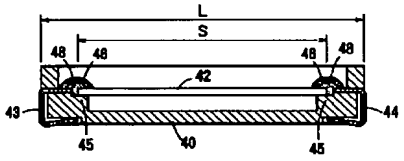
【図７】



【図８】



【図９】



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